ABSORPTION CHILLER-HEATER

The present application is based on Japanese Patent Application No. 2003-31410, the entire contents of which are incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an absorption chiller-heater, particularly relates to an absorption chiller-heater having an exhaust gas fired regenerator constituting a heat source by exhaust gas.

2. Related Art

In an absorption chiller-heater having an exhaust gas fired regenerator constituting a heat source by exhaust gas, in order to promote a rate of recovering heat from exhaust gas, that is, an efficiency of utilizing exhaust heat generated from an exhaust gas source, it is proposed to provide two regenerators of an exhaust gas fired high temperature regenerator and an exhaust gas fired low temperature regenerator or an auxiliary regenerator for utilizing heat of the exhaust gas (refer to, for example, JP-A-11-304274 (pages 3-4, Fig. 1), JP-A-2001-289529 (pages 3-4, Fig. 1), JP-A-2002-162131 (pages 4-6, Fig. 1)). According to the absorption chiller-heaters, in addition to the exhaust gas fired high temperature regenerator, also at the exhaust gas fired low temperature regenerator or the auxiliary regenerator,

a solution of a diluted solution or the like is heated by heat of exhaust gas to thereby generate a cooling medium vapor and a concentrated solution to thereby constitute a cycle generally referred to as single double utilization.

Meanwhile, even with respect to an exhaust heat source exhausting two modes of exhaust heat such as heat recovered by exhaust gas and heat recovered by cooling water as in exhaust heat of a gas engine, a diesel engine or the like, an absorbing type refrigerating machine utilizing these modes of exhaust heat is proposed (refer to, for example, JP-A-2000-46435 (pages 3-7, Figs. 1, 2), JP-A-2001-183028 (page 6, Fig. 2)). JP-A-2000-46435 shows a cycle of utilizing exhaust gas as a heat source of a high temperature regenerator and recovering heat recovered by cooling water by a diluted solution as sensible heat. JP-A-2001-183028 shows an absorbing type refrigerating machine of single double utilization using exhaust gas as a heat source of a high temperature regenerator and using heat recovered by cooling water in a low temperature regenerator.

Meanwhile, according to the constitution of a single double utilization cycle including the low temperature regenerator or the auxiliary regenerator constituting the heat source by exhaust gas from the exhaust heat source or cooling water recovering heat, when an amount of exhaust heat provided to exhaust gas is changed, it is difficult to maintain a cycle

balance of a flow rate or a concentration of the solution. Therefore, there is a case in which the concentration of the solution is excessively concentrated to bring about crystallization.

In contrast thereto, JP-A-2002-162131 proposes to construct a constitution of a state of installing the exhaust gas fired high temperature regenerator and the auxiliary regenerator in parallel with each other to include two of the independent exhaust gas fired regenerators both generating the concentrated solution and the cooling medium vapor by heating the diluted solution. However, when such a constitution is constructed, the constitution is complicated such that a heat exchanger for carrying out heat exchange between the concentrated solution and the diluted solution is further installed or a number of pieces of pipes is increased. Meanwhile, JP-A-2001-183028 proposes to install a controller for carrying out a control for maintaining the cycle balance of the flow rate, the concentration or the like of the solution, however, the control is complicated. Such a complication of the constitution or the control is not preferable since an increase in cost or the like is brought about.

Further, JP-A-2000-46435 proposes to recover heat of cooling water the temperature is elevated by cooling the heat source machine by the diluted solution as sensible heat by carrying out heat exchange between cooling water from the heat

source machine and the diluted solution coming out from the low temperature heat exchanger and before going into the high temperature heat exchanger. In this case, the heat of cooling water is recovered by the diluted solution as sensible heat and therefore, temperature of the diluted solution cannot be elevated to be equal to or higher than the temperature of cooling water. That is, a difference between inlet temperature of cooling water recovering heat and temperature of the diluted solution after having been heated by the concentrated solution at the low temperature heat exchanger is comparatively small. For example, whereas outlet temperature of the low temperature heat exchanger of the diluted solution is about 74°C, the inlet temperature of cooling water is about 90°C and therefore, temperature of the diluted solution can only be elevated from about 74°C to about 90°C or lower at maximum. Therefore, even when a heat amount provided by cooling water is sufficient, there is a limit in a heat amount which can be recovered from cooling water to the diluted solution and it is difficult to promote an efficiency of utilizing exhaust heat generated from the exhaust heat source. Therefore, JP-A-2000-46435 also proposes the single double utilization cycle for guiding cooling water the temperature of which is elevated by cooling the exhaust machine to the low temperature regenerator and in this case, as described above, the complication of the constitution or the

control is brought about.

SUMMARY OF THE INVENTION

The invention is directed to promote an efficiency of utilizing exhaust heat of an absorption chiller-heater while restraining complication of constitution or control.

An absorption chiller-heater of the invention comprises: an exhaust gas flow path in which an exhaust gas flows; an exhaust gas fired regenerator provided on the exhaust gas flow path so as to be heated by the exhaust gas; a cooling medium solution passage supplying a first solution of a cooling medium which is collected by an absorber to the exhaust gas fired regenerator; and an exhaust gas heat collector provided on the cooling medium solution passage for carrying out heat exchange between the first solution and the exhaust gas.

Further the invention may further comprises: a low temperature heat exchanger provided on an upstream side of the cooling medium solution passage with respect to a flow of the first solution therein for carrying out heat exchange between the first solution and a second of the cooling medium; and

a high temperature heat exchanger provided on a downstream side of the cooling medium solution passage with respect to the flow of the first solution therein for carrying out heat exchange between the first solution and a third solution of the cooling medium; wherein the exhaust gas heat collector is provided on the cooling medium solution passage

between the low temperature heat exchanger and the high temperature heat exchanger.

When such a constitution is constructed, heat exchange is carried out between the exhaust gas and the first solution of the cooling medium and therefore, the exhaust gas maintains a comparatively high temperature even after the exhaust gas is made to flow to the exhaust gas fired regenerator and therefore, a temperature difference between the exhaust gas and the first solution coming out from the low temperature heat exchanger is comparatively large. Therefore, a heat amount capable of recovering from the exhaust gas by the first solution is increased even when the heat is sensible heat and the efficiency of utilizing exhaust heat generated from an exhaust heat source can be promoted. Meanwhile, only the heat exchanger for carrying out heat exchange between the exhaust gas and the first solution by the sensible heat is provided at the flow path of the exhaust gas, further, it is not necessary to carry out a control for maintaining a cycle balance of a flow rate, a concentration or the like of the solution. Therefore, increase of complexity of the constitution and the control can be restrained. Therefore, the efficiency of utilizing the exhaust heat can be promoted while restraining complexity of the constitution and control.

Further, when there is constructed a constitution in which the exhaust gas fired regenerator and the exhaust gas

heat collector are formed as an integral unit is constructed, complication of the constitution can be further be restrained.

Further, there is constructed a constitution in which an inlet of the cooling medium solution flow path formed at inside of the exhaust gas heat collector for making the first solution flow is provided on a downstream side of the exhaust gas flow path for making the exhaust gas flow with respect to flow of the exhaust gas and an outlet of the cooling medium solution flow path is provided on an upstream side of the exhaust gas flow path with respect to the flow of the exhaust gas. When such a constitution is constructed, the heat recovering rate of the exhaust gas heat collector can be promoted and the efficiency of utilizing the exhaust heat can further be promoted.

Further, there is constructed a constitution including a plurality of heat transfer pipes in a shape of a straight pipe arranged with cooling medium solution flow paths for making the first solution of the exhaust gas heat collector flow in parallel and in which the heat transfer pipes are arranged in a lateral direction. When such a constitution is constructed, the constitution of the exhaust gas heat collector for recovering heat by sensible heat can be simplified and the coat can be reduced.

Further, there is constructed a constitution in which a second unit integrally formed with the exhaust gas fired

regenerator and the exhaust gas heat collector is mounted above a first unit integrally formed with the low temperature regenerator, a condenser, the absorber and an evaporator. When such a constitution is constructed, the first unit is difficult to receive heat generated by the second unit having the exhaust gas fired regenerator and the exhaust gas heat collector and a factor of malfunction can be reduced.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a diagram showing an outline constitution of a first embodiment of an absorption chiller-heater constituted by applying the invention;

Fig. 2 is a diagram showing a modified example of the first embodiment;

Fig. 3 is a diagram showing an outline constitution of a second embodiment of an absorption chiller-heater constituted by applying the invention;

Figs. 4A and 4B illustrate sectional views showing an outline constitution of a unit comprising an exhaust gas fired regenerator and an exhaust gas heat collector installed at the absorption chiller-heater of the second embodiment, Fig. 4A is a plan view and Fig. 4B is a front view;

Fig. 5 is a perspective view showing an outlook of the second embodiment of the absorption chiller-heater constituted by applying the invention;

Fig. 6 is a diagram showing an absorption chiller-heater

of a series flow type as a modified example of the second embodiment; and

Fig. 7 is a diagram showing an absorption chiller-heater of a parallel flow type as a modified example of the second embodiment.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

(First Embodiment)

An explanation will be given of a first embodiment of an absorption chiller-heater constituted by applying the invention in reference to Fig. 1 as follows. Fig. 1 is a diagram showing an outline constitution of an absorption chiller-heater constituted by applying the invention.

As shown by Fig. 1, the absorption chiller-heater of the embodiment is constituted by an exhaust gas fired regenerator 1, a low temperature regenerator 3, a condenser 5, an evaporator 7, an absorber 9 and the like. The exhaust gas fired regenerator 1 is for carrying out heat exchange between supplied diluted solution (first solution of the invention) of cooling medium and exhaust gas from external machine generating exhaust gas by combustion so at to generate cooling medium vapor and concentrated solutions (second and third solutions of the invention) by heating the diluted solution by heat provided to exhaust gas. Such an exhaust gas fired regenerator 1 is installed on a lower side or in a side direction of a unit 11 comprising the low temperature regenerator 3, the

condenser 5, the evaporator 7 and the absorber 9 or the like.

The exhaust gas fired regenerator 1 is connected with an introducing duct 13 constituting a flow path for guiding exhaust gas from the external machine or the like for generating exhaust gas by combustion to a flow path of exhaust gas at inside of the exhaust gas fired regenerator 1 and an exhaust duct 15 constituting a flow path for exhausting exhaust gas from the flow path of exhaust gas at inside of the exhaust gas fired regenerator 1. The introducing duct 13 and the exhaust duct 15 are connected by a bypass duct 17 constituting a bypass flow path branched from the introducing duct 13 and merging the exhaust duct 15. A branch portion of the introducing duct 13 and the bypass duct 17 is provided with flow path switching device 19 for switching flow of exhaust gas to the introducing duct 13 and the bypass duct 17. A portion of the exhaust duct 1 on an upstream side of a merging portion 21 of the bypass duct 17 and the exhaust duct 15 with respect to flow of exhaust gas is provided with cut-off device 23 including a damper or the like for cutting off flow of exhaust gas at inside of the exhaust duct 15. In this way, the introducing duct 13 and the exhaust duct 15 form an exhaust gas flow path for making exhaust gas flow to the exhaust gas fired regenerator.

Such an exhaust gas fired regenerator 1 is connected with a diluted solution passage (cooling medium solution passage) 25 for guiding a diluted solution (first solution) generated

by absorbing a cooling medium vapor by a concentrated solution (third solution) at the absorber 9 to a flow path of the diluted solution at inside of the exhaust gas fired regenerator 1. An outlet portion from the absorber 9 of the diluted solution passage 25 is provided with a pump 27 for delivering the diluted solution. An upper portion of the exhaust gas fired regenerator 1 is connected with one end of a solution lifting passage 29 in which the cooling medium vapor and the concentrated solution generated at inside of the exhaust gas fired regenerator 1 flows and other end of the solution passage 29 is connected to a gas-liquid separator 31 for separating the cooling medium vapor and the concentrated solution.

Inside of the low temperature regenerator 3 is installed with a heat exchange flow path 3a communicated with inside of the gas-liquid separator 31 for making the cooing medium vapor separated at inside of the gas-liquid separator 31 flow. The heat exchange flow path 3a is connected with a cooling medium vapor passage 33 for guiding the cooling medium vapor flowing at inside of the heat exchange flow path 3a heated by the low temperature regenerator 3 to the condenser 5. Further, the low temperature regenerator 3 is connected with other end of a middle concentration solution passage 35 one end of which is connected to a bottom portion of the gas-liquid separator 31. Further, the low temperature regenerator 3 is connected with one end of a concentrated solution passage 37 for

constituting a concentrated solution by heating a middle concentration solution (second solution) which flows from the middle concentration solution passage 35 by heat of the cooling medium vapor flowing at inside of the heat exchange flow path 3a and thereafter delivering the concentrated solution to the absorber 9. Other end of the concentrated solution passage 37 is connected to the absorber 9.

Inside of the condenser 5 is provided with a heat exchange flow path 5a forming a portion of a flow path of cooling water by being connected to a cooling water passage 39 in which cooling water flows. A bottom portion of the condenser 5 is connected with one end of a cooling medium passage 41 in which a cooling medium solution constituted by condensing to liquefy the cooling medium vapor. Other end of the cooling medium solution passage 41 is connected to a cooling medium scattering portion, not illustrated, provided at inside of the evaporator 7. Inside of the evaporator 7 is connected with a heat exchange flow path 7a connected with a cooled water passage 43 in which a cooling medium for an indoor unit cooled or heated at inside of the evaporator 7 and delivered to an indoor unit or the like for air conditioning, for example, water flows and forming a portion of a flow path of water constituting the cooling medium for the indoor unit and the cooling medium scattering portion, not illustrated, scatters the cooling medium to the heat exchange flow path 7a.

The absorber 9 is actually connected with the evaporator 7, although not illustrated in Fig. 1, and is constituted such that the cooling medium vapor generated at the evaporator 7 can flow into the absorber 9. Inside of the absorber 9 is provided with a heat exchange flow path 9a connected with a cooling water passage 39 and forming a portion of a flow path of cooling water. Further, inside of the absorber 9 is provided with a concentrated solution scattering portion, not illustrated, or the like connected with the concentrated solution passage 37 for scattering the concentrated solution to the heat exchange flow path 9a. A bottom portion of the absorber 9 is connected with one end of the diluted solution passage 25 for delivering the diluted solution generated by absorbing the cooling medium vapor generated at the evaporator 7 by the concentrated solution to the exhaust gas fired regenerator 1.

The middle concentration solution passage 35 is merged with a branch passage 45 branched from the diluted solution passage 25. Further, a portion of the middle concentration solution passage 35 between the gas-liquid separator 31 and a portion thereof merged with the branch passage 45 is provided with a high temperature heat exchanger 47 for carrying out heat exchange between the diluted solution flowing in the diluted solution passage 25 and a middle concentration solution (third solution) flowing in the middle concentration solution passage

35. Further, the high temperature heat exchange 47 is provided at a portion of the diluted solution passage 25 on a downstream side of the portion branched with the branch passage 45 with respect to flow of the diluted solution. A portion of the diluted solution passage 25 on the downstream side of the pump 27 and on the upstream side of the portion branched with the branch passage 45 is provided with a low temperature heat exchanger 49 for carrying out heat exchange between the diluted solution flowing in the diluted solution passage 25 and the concentrated solution flowing in the concentrated solution passage 37. Further, the cooling water passage 39 is arranged such that cooling water is circulated from the absorber 9 to a cooling tower, not illustrated, by passing the condenser 5.

Although the constitution explained up to this point is the same as a publicly-known absorption chiller-heater of a bypass flow type having an exhaust gas fired regenerator and in which a portion of a diluted solution flowing in a diluted solution passage is mixed with a concentrated solution flowing in a middle concentration solution passage by a branch passage to deliver to a low temperature regenerator, the absorption chiller-heater of the embodiment is provided with an exhaust gas heat collector 51 for recovering heat of exhaust gas to the diluted solution by carrying out heat exchange between exhaust gas and diluted solution at the exhaust duct 15 in which exhaust gas flows.

That is, the exhaust gas heat collector 51 includes a heat exchange flow path 51a in which exhaust gas flows and a heat exchange flow path 51b in which the diluted solution flows. Further, the exhaust gas heat collector 51 is provided on the downstream side of the exhaust gas fired regenerator 1 of the exhaust gas flow path with respect to flow of exhaust gas, that is, the exhaust duct 15. A portion of the exhaust duct 15 for guiding exhaust gas exhausted from the exhaust gas fired regenerator 1 to the exhaust gas heat collector 51 and a portion of the exhaust duct 15 for exhausting exhaust gas from the exhaust gas heat collector 51 are respectively connected to the heat exchange flow path 51a in which exhaust gas of the exhaust gas heat collector 51 flows. The diluted solution passage 25 is connected to the heat exchange flow path 51b which is a portion between the low temperature heat exchanger 49 and the high temperature heat exchanger 47 of the diluted solution passage 25 and in which the diluted solution of the exhaust gas heat collector 51 flows.

An explanation will be given of operation related to the exhaust gas heat collector 51 of the absorption chiller-heater having such a constitution and a characterizing portion of the invention. The diluted solution generated by absorbing the cooling medium vapor by the concentrated solution by the absorber 9 of the absorption chiller-heater flows into the diluted solution passage 25 by driving the pump 27, firstly

carries out heat exchange with the concentrated solution generated by the low temperature regenerator 3 at the low temperature heat exchanger 49 to thereby elevate temperature thereof to, for example, about 74°C. Next, the diluted solution the temperature of which is elevated by the low temperature heat exchanger 49 carries out heat exchange with exhaust gas the heat of which is recovered by the exhaust heat fired regenerator 1 to lower temperature thereof at the exhaust gas heat collector 51.

Here, when external machine generating exhaust gas is, for example, micro gas turbine or the like, temperature of the exhaust gas becomes about 250°C through 300°C. Further, the temperature of exhaust gas at about 200°C through 300°C is lowered to about 170°C through 180°C by heating the diluted solution by carrying out heat exchange with the diluted solution at inside of the exhaust gas fired regenerating 1. The exhaust gas at temperature of about 170°C through 180°C flows into the exhaust gas heat collector 51. Therefore, at the exhaust gas heat collector 51, heat exchange is carried out by sensible heat between exhaust gas temperature of, for example, about 170°C through 180°C and the diluted solution at about 74°C and temperature of the diluted solution is elevated up to about 120°C. Meanwhile, temperature of the exhaust gas is lowered to about 110°C through 120°C at the exhaust gas heat collector 51 and the exhaust gas is exhausted

to outside via the exhaust duct 15.

Finally, the diluted solution the temperature of which is elevated to, for example, about 120°C at the exhaust gas heat collector 51 carries out heat exchange with the concentrated solution generated by the exhaust gas fired regenerator 1 at the high temperature heat exchanger 47, temperature of which is elevated to 140°C or higher and the diluted solution is delivered to the exhaust gas fired regenerator 1. At the exhaust gas fired regenerator 1, the diluted solution the temperature of which is elevated to 140°C or higher is heated by heat input from exhaust gas, the cooling medium in the diluted solution is boiled and evaporated to thereby generate the cooling medium vapor and the concentrated solution.

In this way, according to the absorption chiller-heater of the embodiment, heat exchange is carried out between exhaust gas coming from the exhaust gas fired regenerator 1 and the diluted solution coming out from the low temperature heat exchanger at the exhaust heat collector 51 and a difference of temperatures of exhaust gas coming out from the exhaust gas fired regenerator 1 and the diluted solution coming out from the low temperature heat exchanger is comparatively large. Therefore, even in the case of sensible heat, a heat amount which can be recovered from the exhaust gas to the diluted solution is increased and the efficiency of utilizing exhaust

heat generated from the exhaust heat source can be promoted. Meanwhile, in changing the constitution of the absorption chiller-heater, the exhaust duct 15 is only provided with the exhaust gas heat collector 51 for carrying out heat exchange between exhaust gas and the diluted solution as sensible heat and only the diluted solution passage 25 is extended to connect to the exhaust gas heat collector 51 provided at the exhaust duct 15. Further, with respect to the control, it is not necessary to carry out the control for maintaining the cycle balance of the flow rate, the concentration or the like of the solution and the control hardly needs to change. Therefore, the efficiency of utilizing exhaust heat can be promoted while restraining complication of the constitution or the control.

Further, the energy conservation performance can further be promoted by enabling to promote the efficiency of utilizing exhaust heat. In addition thereto, an increase in cost can be restrained since complication of the constitution or the control is restrained. Further, since temperature of the diluted solution flowing into the exhaust gas fired regenerator 1 can be elevated, COP or cooling output can be promoted. In addition thereto, the exhaust gas heat collector 51 is for recovering sensible heat and is not accompanied by boiling as in the regenerator and therefore, the structure can be simplified in comparison with that of the regenerator, further, when a heat transfer pipe or the like is used, there

is no restriction on a state of arranging the heat transfer pipe.

Further, according to the embodiment, the absorption chiller-heater having only the exhaust gas fired regenerator 1 is exemplified. However, there can also be constructed a constitution of including a directly-fired regenerator constituting a heat source by combustion heat of a burner in addition to the exhaust gas fired regenerator 1 such that the absorption chiller-heater can be operated in correspondence with a load of an air conditioning load or the like when the heat amount of exhaust gas is deficient or is not provided.

For example, as shown by Fig. 2, it is also possible to construct a constitution of providing a directly-fired regenerator 53 in series with the exhaust gas fired regenerator 1 on the lower side of the exhaust gas fired regenerator 1 with respect to flow of the cooling medium vapor and the solution to the gas-liquid separator 31. In this case, the solution lifting passage 29 is connected to the directly-fired regenerator 53. Further, the exhaust gas heat collector 51 is provided on the downstream side of the exhaust gas fired regenerator 1 in the exhaust gas flow path with respect to flow of exhaust gas, that is, at the exhaust duct 15. The portion of the exhaust duct 15 for guiding the exhaust gas exhausted from the exhaust gas fired regenerator 1 to the exhaust gas heat collector 51 and the portion of the exhaust duct 15 for

exhausting the exhaust gas from the exhaust gas heat collector 51 are respectively connected to the heat exchange flow path 51a in which exhaust gas of the exhaust gas heat collector 51 flows. The diluted solution passage 25 is connected to the heat exchange flow path 51b which is a portion of the diluted solution passage 25 between the low temperature heat exchanger 49 and the high temperature heat exchanger 47 and in which the diluted solution of the exhaust gas heat collector 51 flows similar to the embodiment. Further, the other constitution is the same as that of the embodiment and therefore, the other constitution is attached with the same notation and an explanation thereof will be omitted.

(Second Embodiment)

An explanation will be given of a second embodiment of an absorption chiller-heater constituted by applying the invention in reference to Fig. 3 through Fig. 5 as follows. Fig. 3 is a diagram showing an outline constitution of an absorption chiller-heater constituted by applying the invention. Figs. 4A and 4B illustrate sectional views showing an outline constitution of a unit comprising an exhaust gas fired regenerator and an exhaust gas heat gas collector installed to the absorption chiller-heater constituted by applying the invention, Fig. 4A is a plan view and Fig. 4B is a front view. Fig. 5 is a perspective view showing an outlook of the absorption chiller-heater constituted by applying the

invention. Further, according to the embodiment, a constitution or the like the same as that of the first embodiment is attached with the same notation, an explanation thereof will be omitted and an explanation will be given of a constitution, a characterizing portion and the like which differ from those of the first embodiment.

A point that the absorption chiller-heater of the embodiment differs from the first embodiment resides in that a single unit is constituted by integrally forming an exhaust gas fired regenerator and an exhaust gas heat collector and the unit comprising the exhaust gas fired regenerator, the exhaust gas heat collector and the like is mounted above a unit comprising a low temperature regenerator, a condenser, an evaporator and an absorber and the like. That is, according to an absorption chiller-heater of the embodiment, as shown by Fig. 3, a second unit 59 integrally unitizing an exhaust gas fired regenerator 55 and an exhaust gas heat collector 57 is mounted above the first unit 11 comprising the low temperature regenerator 3, the condenser 5, the evaporator 7, the absorber 9 and the like. The second unit 59 is brought into a state of connecting the introducing duct 13 to the exhaust gas fired regenerator 55 and connecting the exhaust duct 15 to the exhaust gas heat collector 57.

Further, the embodiment is provided with the directly-fired regenerator 61 constituting a heat source by

combustion heat of a burner such that the absorption chiller-heater can be operated in correspondence with a load of an air conditioning load or the like when a heat amount of exhaust gas is deficient or is not provided. The diluted solution passage 25 is connected to the exhaust gas fired regenerator 55 of the second unit 59. A solution passage 63 for guiding a solution at inside of the exhaust gas fired regenerator 55 to the directly-fired regenerator 61 is provided between the exhaust gas fired regenerator 55 and the directly-fired regenerator 61. Further, the cooling medium vapor passage 65 for guiding the cooling medium vapor generated at inside of the exhaust gas fired regenerator 55 into the gas-liquid separator 31 is provided between the exhaust fired regenerator 55 and the gas-liquid separator 31.

An explanation will be given here of the structure of the second unit 59 integrally unitizing the exhaust gas fired regenerator 55 and exhaust gas heat collector 57. As shown by Figs. 4A and 4B, the second unit 59 is formed by a cabinet 59a having a hollow inner portion, connecting portions 59b, 59c provided at both ends of the cabinet 59a, an upper side header chamber 55a and a lower side header chamber 55b each formed in a jacket shape constituting the exhaust gas fired regenerator 55, a heat transfer tube 55c constituting the exhaust gas fired regenerator 55, a heat transfer pipe 57a constituting the exhaust gas heat collector 57 and the like.

The cabinet 59a is constituted by a shape of respectively providing the connecting portions 59b, 59c at both end portions of a parallelepiped flatly extended in one direction via portions in a taper shape widths of which between side faces are reduced successively toward ends of the both end portions. A space at inside of the cabinet 59a constitutes a flow path 59d of exhaust gas flowing therein from either of the connecting portions 59b, 59c and flowing out from other thereof. Further, the second unit 59 is installed by constituting an upper face and a lower face thereof by faces of the cabinet 59a having wide widths and constituting two side faces by faces having narrow widths.

The exhaust gas fired regenerator 55 is formed at about a half portion of the cabinet 59a on the side of the connecting portion 59b. The upper side header chamber 55a and the lower side header chamber 55b are formed in the jacket shape respectively on the upper face side and the lower face side of the portion of the cabinet 59a. The upper side header chamber 55a and the lower side header chamber 55b are provided in parallel between the upper face and the lower face of the cabinet 59a and communicated with each other by a plurality of the heat transfer pipes 55c inserted in an up and down direction at the flow path 59d at inside of the cabinet 59a. The heat transfer pipe 55c is a heat transfer pipe of a so-to-speak fin tube type in a shape of a straight pipe provided

with a plurality of heat transfer fins 55d in a circular disk shape at an outer surface thereof.

The exhaust gas heat collector 57 is formed at about a half portion of the cabinet 59a on the side of the connecting portion 59c. A plurality of the heat transfer pipes 57a inserted in a lateral direction of the flow path 59d at inside of the cabinet 59a are arranged in parallel between side faces of the portion of the cabinet 59a opposed to each other. Both end portions of the heat transfer pipe 57a are projected to outer sides from the side faces of the cabinet 59a opposed to each other and end portions of contiguous ones of the heat transfer pipes 57a are connected by connecting pipes 57b formed in a semicircular arc shape except an end portion of the heat transfer pipe 57a connected with the diluted solution passage 25 to thereby form a meandering flow path of the diluted solution. The heat transfer pipe 57a is also a heat transfer pipe of a so-to-speak fin tube type in a shape of a straight pipe provided with a plurality of heat transfer fins 57c in a circular disk shape at a surface thereof.

End portions of the connecting portions 59b, 59c are respectively formed with flange portions 59e, 59f in a flange shape and either of the introducing duct 13 and the exhaust duct 15 is connected by the flange portion 59e, 59f. According to the embodiment, the exhaust gas fired regenerator 55 is disposed on the upstream side with respect to flow of exhaust

gas, the exhaust gas heat collector 57 is disposed on the downstream side and therefore, the connecting portion 59b on the side of the exhaust gas fired regenerator 55 is connected with the introducing duct 13 and the connecting portion 59c on the side of the exhaust gas heat collector 57 is connect with the exhaust duct 15, respectively.

When the second unit 59 is connected with the exhaust gas fired regenerator 55 on the upstream side and connected with the exhaust gas heat collector 57 on the downstream side in this way, a connecting port portion, not illustrated, provided on the downstream side with respect to flow of exhaust gas at inside of the cabinet 29a of the lower side header chamber 55b of the exhaust gas fired regenerator 55 is connected with one end of the diluted solution passage 25 and a connecting port portion, not illustrated, provided on the upstream side of the lower header chamber 55b is connected with one end of the solution passage 63, respectively. Further, a connecting end portion of the heat transfer pipe 57a disposed on the downstream side with respect to flow of exhaust gas at inside of the cabinet 59a of the exhaust gas heat collector 57 is connected with the diluted solution passage 25 from the low temperature heat exchanger 49 and a connecting end portion of the heat transfer pipe 57a disposed on the upstream side is connected with the diluted solution passage 25 to the high temperature heat exchanger 47, respectively. Further, the

upper side head chamber 55a of the exhaust gas fired regenerator 55 is connected with the cooling medium vapor passage 65 for guiding the cooling medium vapor at inside of the upper side header chamber 55a to the gas-liquid separator 31.

By connecting the respective passages 25, 63 and the like in this way, at the exhaust gas fired regenerator 55, the diluted solution is brought in from the downstream side with respect to flow of exhaust gas at inside of the cabinet 59a to the lower side header chamber 55b and the concentrated solution is brought out to the lower side head chamber 25b from the upstream side. Further, at the exhaust gas heat collector 57, the diluted solution is brought in the heat transfer pipe 57a disposed on the downstream side with respect to flow of exhaust gas at inside of the cabinet 59a and the diluted solution is brought out from the heat transfer pipe 57a disposed on the upstream side. That is, at the exhaust gas heat collector 57, the diluted solution is brought in from the downstream side with respect to flow of exhaust gas at inside of the cabinet 59a in the flow path of the diluted solution formed by the heat transfer pipe 57a and the connecting pipe 57b and the diluted solution is brought out from the upstream side. Thereby, the heat exchange efficiency is promoted and the rate of recovering heat from exhaust gas is promoted.

According to the absorption chiller-heater of the embodiment mounting the second unit 59 above the first unit,

as shown by Fig. 5, an outlook thereof is constituted by a single quadrangular pillar shape by a panel 67 disposed on the lower side for covering the second unit 11 and a panel 69 covering the first unit 59. The panel 67 covering the second unit 11 and the panel 69 covering the first unit 59 are attached to a frame comprising rod-like steel members integrated in the quadrangular pillar shape surrounding the second unit 11 and the first unit 59. Each of the panels 67 covering the second unit 11 is formed with a louver 71 constituting a vent proximately to the upper side. Further, the upper side of the second unit 59 is installed with a ceiling panel although not illustrated in Fig. 5.

In this way, even in the case of the absorption chiller-heater of the embodiment, an effect the same as that of the first embodiment can be achieved. Further, according to the absorption chiller-heater of the embodiment, there is constituted the second unit 59 integrally formed with the exhaust gas fired regenerator 55 and the exhaust gas heat collector 57 by making the flow path of exhaust gas common and therefore, an increase in cost by providing the exhaust gas heat collector 57 can be restrained, further, in comparison with a case of providing a single one of the exhaust heat collector, the exhaust gas heat collector can be downsized. In addition thereto, when the exhaust gas heat collector is provided, the second unit 59 is installed at the flow path of

exhaust gas and only the diluted solution passage 25 is extended to the portion of the exhaust gas heat collector 57 of the second unit 59 and therefore, complication of the constitution can further be restrained.

Further, the inlet of the diluted solution flow path formed by the heat transfer pipe 57a and the connecting pipe 57b formed at the exhaust gas heat collector 57 for making the diluted solution flow is provided on the downstream side with respect to exhaust gas in the flow path 59d of exhaust gas at inside of the cabinet 59a and the outlet of the diluted solution flow path is provided on the upstream side. Therefore, the heat recovering rate at the exhaust heat collector 57 can be promoted and the efficiency of utilizing exhaust heat can further be promoted.

Further, there are provided a plurality of heat transfer pipe 57a in the shape of the straight pipe arranged with the diluted solution flow paths for making the diluted solution flow of the exhaust gas heat collector 57 in parallel and the heat transfer pipes 57a are arranged in the lateral direction at inside of the exhaust gas heat collector 57. Therefore, by enabling to simplifying the constitution of the exhaust gas heat collector for recovering heat by sensible heat, the cost can further be reduced. Further, there is a degree of freedom in a length, a number of stages or a number of rows of the heat transfer pipes and therefore, the height can be adjusted in

accordance with an installation space and a restriction on the site of installation can be reduced. Further, since the height of the portion of the exhaust gas heat collector 57 can be lowered, the machine can be downsized. In addition thereto, when there are provided the plurality of heat transfer pipes 57a in the shape of the straight pipe arranged with the diluted solution flow paths for making the diluted solution flow of the exhaust gas heat collector 57 in parallel, by prolonging the length of the heat transfer pipe 57a, a number of pieces of installing the heat transfer pipes can be reduced and the cost can be restrained.

Further, since the second unit 59 is mounted above the first unit 11, heat irradiated from the exhaust gas fired regenerator 55 and the exhaust gas heat collector 57 of the second unit 59 is escaped to the upper side or in the side direction of the second unit 59. Therefore, heat irradiated from the second unit 59 is difficult to influence on the first unit 11. Therefore, rise in temperature at inside of the first unit 11 by influence of heat irradiated from the second unit 59 is difficult to be brought about, reliability of parts at inside of the first unit can be promoted and factors of malfunction can be reduced. In addition thereto, even when the second unit 59 is provided, an installation area thereof remains unchanged from that of the case of only the first unit 11 and the installation area can be restrained from being

increased and therefore, the restriction on the site of installation can be reduced.

Further, although according to the embodiment, the constitution of the absorption chiller-heater of the bypass flow type is shown as an example, the invention is not limited to the bypass flow type but is applicable to absorption chiller-heaters of a series flow type and parallel flow type.

For example, according to an absorption chiller-heater of a series flow type, as shown by Fig. 6, although the constitution is substantially the same as the constitution of the absorption chiller-heater of the bypass water according to the embodiment, the constitution differs in that there is not provided the branch passage 45 branched from the diluted solution passage 25 and merged to the middle concentration solution passage 35. Further, the constitution and the position of installing the second unit 59, the position of connecting the diluted solution passage 25 to the exhaust gas heat collector 57 and the like are the same as those of the embodiment.

Meanwhile, according to an absorption chiller-heater of a parallel flow type, as shown by Fig. 7, other than the gas-liquid separator 31, a sub gas-liquid separator 73 is provided. Further, in place of the middle concentration passage 35 of the embodiment, a first concentrated solution passage 75 for guiding the concentrated solution separated at

the gas-liquid separator 31 to the sub gas-liquid separator 73 is provided between the gas-liquid separator 31 and the sub gas-liquid separator 73. The first concentrated solution passage 75 is provided with the high temperature heat exchanger 47. The sub gas-liquid separator 73 is connected with one end of a second concentrated solution passage 77 for guiding the concentrated solution provided by further separating gas and liquid by the sub gas-liquid separator 73 to the absorber 9. Other end of the second concentrated solution passage 77 is connected to the absorber 9. The low temperature heat exchanger 49 is provided to the second concentrated solution passage 77. Further, the sub gas-liquid separator 73 is connected with one end of a sub cooling medium vapor passage 79 for guiding cooling medium vapor provided by further separating gas and liquid by the sub gas-liquid separator 73 to the condenser 5. Other end of the sub cooling medium vapor passage 79 is connected to the condenser 5.

A portion of the diluted solution passage 25 between the low temperature heat exchanger 49 and the exhaust gas heat collector 57 is connected with one end of a branch passage 81 branched from the diluted solution passage 25. Other end of the branch passage 81 is connected to the low temperature regenerator 3. A solution passage 83 merged to the second concentrated solution passage 77 is provided between the low temperature regenerator 3 and the second concentrated solution

passage 77. The diluted solution flowing from the branch passage 81 to the low temperature regenerator 3 is heated and concentrated by heat of cooling medium vapor, flows to the second concentrated solution passage 77 via the solution passage 83, mixed with the concentrated solution from the concentrated solution from the sub gas-liquid separator 73 and is delivered to the absorber 9. The other constitution is the same as the constitution of the absorption chiller-heater according to the embodiment.

Further, although according to the first and the second embodiments, water is exemplified as cooling medium for an indoor unit, various media can be used as media for the indoor unit.

Further, the invention is not limited to the absorption chiller-heater having the first and the second constitutions exemplified here and modified examples of these but is applicable to absorption chiller-heaters of various constitutions having exhaust gas fired regenerators.

The exhaust gas is not limited to a wasted gas exhausted from external machines. Various kind of heated fluids may be utilized for heating the exhaust gas fired regenerator of the invention.

According to the invention, the efficiency of utilizing exhaust heat can be promoted while restraining complication of the constitution and the control.